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NASA TECHNICAL TRANSLATION

NASA TT F-14,735

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(NASA-TT-F-14735) STUDY OF CLOUDINESS PARAMETERS BASED ON MEASUREMENTS FROM THE KOSMOS-384 SATELLITE (Scientific Translation Service) ~~9~~ 8 p HC $4.00 CSCL 04B G3/20

N74-22282

Unclas 37866

Translation of: "Issledovaniya parametrov oblachnosti po izmereniyam so sputnika "kosmos-384". Izvestiya Akademii Nauk SSSR, Fizika Atmosfery i Okeana, Vol. IX, No. 2, 1973, pp. 187-189

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546 JULY 1973

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The Satellite Kosmos-384 made studies of the thermal radia- /187* tion of the atmosphere-underlying surface system, which were begun with the satellite Kosmos-243 [1]. Kosmos-384 was placed into orbit on December 10, 1970. The inclination of the satellite

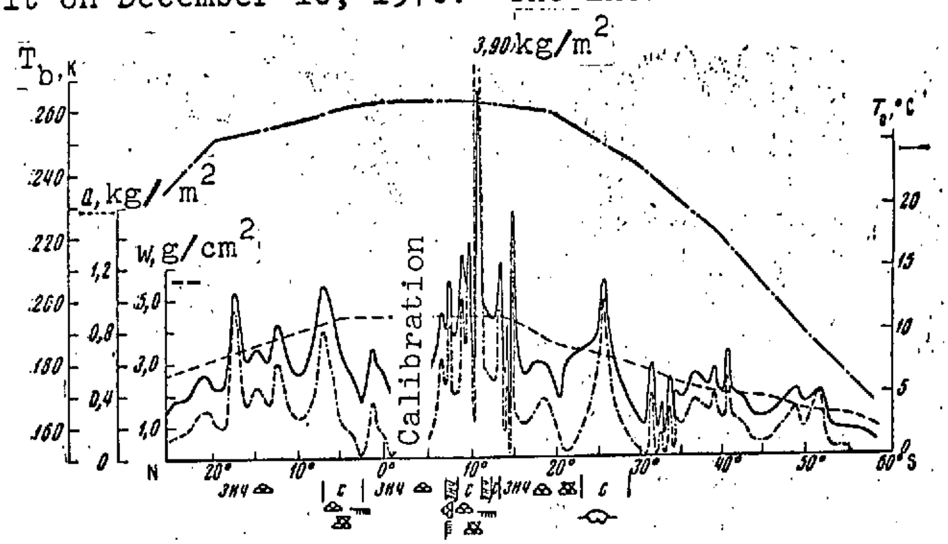

Figure 1. Behavior of the brightness temperature T_b at a wavelength of 0.8 cm, water reserve of the clouds W, mean monthly values of the atmospheric water content Q, and ocean surface temperature along the projection of the satellite orbit over the Pacific Ocean (December 10, 1970).

* Numbers in the margin indicate pagination in the original foreign text.

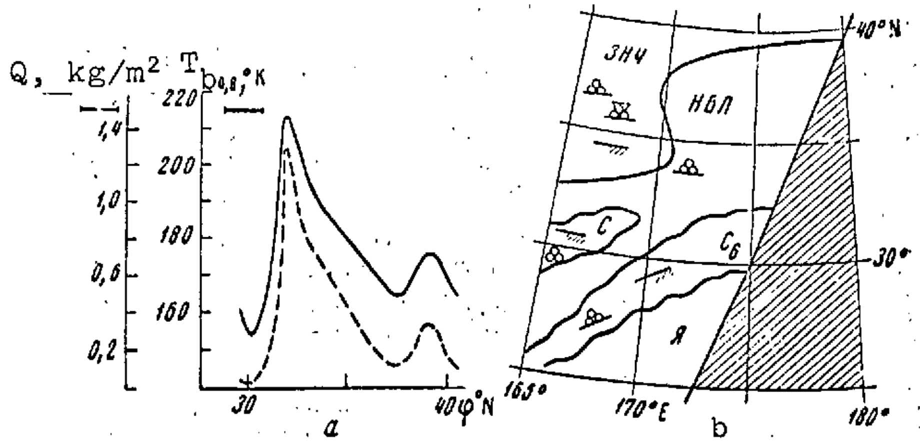

Figure 2. a - Behavior of radio brightness temperature T_b at a wavelength of 0.8 cm and the water reserve of the clouds W, when a cold front is intersected; b - Map of turbidity analysis in this region. / 188

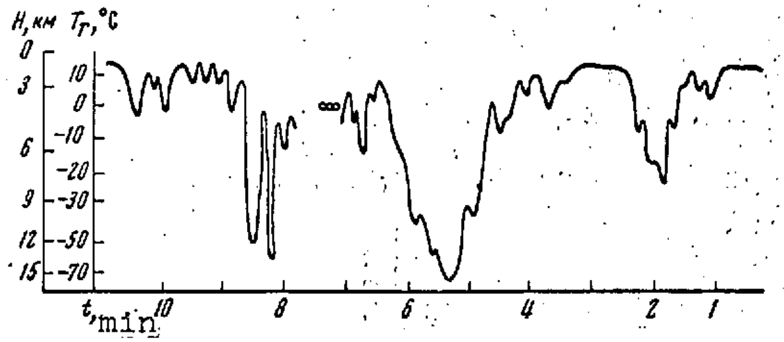

Figure 3. Determination of the upper cloud boundary based on measurements in the infrared region above the Pacific Ocean.

orbital plane to the plane of the equator was 72.9°, the perigee was 212 kilometers, and the apogee was 314 kilometers.

This article investigates the results of measurements at wavelengths of 0.8 cm and 10-12 micrometers when studying the cloudiness parameters. Both the results of a synoptic analysis of the USSR Hydrometeorological Center and the main climatic data were used for the analysis.

Variations in the radio brighteness temperature at a wavelength of 0.8 cm T_b above the oceans were determined primarily by changes in the water content in the atmosphere — with clouds and precipitation [2]. Figure 1 shows the distribution of the brightness temperature during the satellite flight from 20°N to 60°S above the Pacific Ocean, whose general features are similar to the distributions obtained on Kosmos-243. In this section of the trajectory, the ocean was greatly covered with clouds, which may be seen from the television pictures obtained in this region. The great changes in the brightness temperature point to the wide range of variations in the integral content of water in the clouds.

The water reserve of the clouds W, which is also shown in Figure 1, was calculated from measurements of the radio brightness temperature. For calculations of W, we use the mean climatic data on the ocean surface temperature T_0 and on the integral humidity Q over the ocean in January. In regions where the brightness temperature was greater than 200°K, the presence of clouds above the ocean was very probable [2].

Figure 2-a, shows the behavior of the radio brightness temperature at a wavelength of 0.8 cm and the change in the cloud water reserve W above the center portion of the Pacific Ocean in the region of 30-40° N where the projection of the orbit for the Kosmos-384 satellite intersects a cold-front at the angle 45°. On the turbidity analysis map, which is based on data obtained from satellite ITOS-1 (Figure 2 b), in this region there is dense cloudiness and Cirrus and Cirrocumulus clouds. On the synoptic map obtained on December 11, 1970, there is a line of a front and precipitation in this region. Radiometric measurements in agreement with the synoptic maps show an increase in the cloud water reserve as the front is approached, and the radio brightness /188

temperature increases greatly. The estimate of the maximum water reserve is about 1.3 kg/m^2. Apparently, clouds occur in the region where there is a maximum of the brightness temperature.

We should note that in all of the cases observed, when atmospheric fronts were intersected over the ocean, there was a great increase in the radio brightness at a wavelength of 0.8 cm, just as occurred in the experiment on the satellite Kosmos-243.

Using the method given in [3-5], we may estimate the height of the upper cloud boundary over the Pacific Ocean based on measurements of the radiation temperature in the 10-12 micrometer range. Figure 3 shows the behavior of the radiation temperature above the equatorial region of the Pacific Ocean. A transition is made to the scale of the height of the upper cloud boundary by means of the mean climatic data on the vertical temperature profile. The example shown in Figure 3, in which the height of the clouds reaches up to 15 kilometers, is characteristic for the equatorial zone with strong clouds of vertical development.

Synchronous measurements in the infrared and microwave range make it possible to expand our information regarding the structure of the cloud system above the ocean. Figure 4 shows synchronous recordings obtained in the Southern hemisphere over the Pacific Ocean. /189

In Part 1, the behavior of the radiation temperature at a wavelength of 10-12 micrometers is essentially the mirror image of the radio brightness at a wavelength of 0.8 cm.* This indicates that in this region for several hundred kilometers, the increase in the cloud water content with the possible formation of precipitation, is accompanied by an increase in their upper boundary.

In Section 2, the relationship between the water content and the height of the upper boundary is more complex, and the greatest height of the clouds does not coincide with the maximum water reserve. This leads to the assumption of the development of icy clouds in the upper stratum, which do not occur at observations at a wavelength of 0.8 cm.

In conclusion, we should note that measurements performed on Kosmos-384 supplement the results of measurements performed previously on Kosmos-243, which provided data on another season. The results of their processing provide further corroboration of the possibilities of using a complex of satellite measurements of thermal radiation in the radio- and infrared regions and television pictures to obtain quaintitative data on the atmosphere.

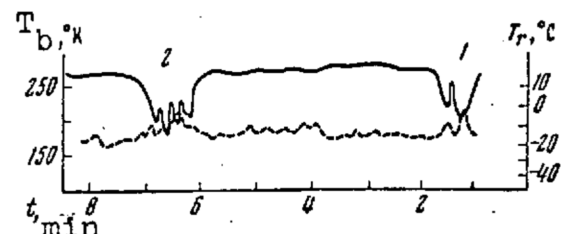

Figure 4. Synchronous measurements of the radio brightness T_b (--) and the radiation temperature T_r (—) over the Pacific Ocean.

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* We should recall that an increase in the height of the upper boundary of dense clouds with emissivity which is close to unity, leads to a decrease in their radiation temperature in the infrared region. An increase in the cloud water content above the ocean leads to an increase in their radio brightness at a wavelength of 0.8 cm.

REFERENCES

1. Basharinov, A. Ye., A. S. Gurvich and S. T. Yegorov. Determination of the Geophysical Parameters Based on Measurements of Thermal Radio Emission on Kosmos-243. Doklady AN SSSR, 188, No. 6, 1273, 1969.

2. Akvilonova, A. B., L. M. Mitnik and B. G. Kutuza. Altitudinal Distribution of Integral Water Content of the Clouds Above the Earth Based on Data from Measurements on Kosmos-243. AN SSSR, Fizika atmosfery i okeana, 7, No. 2, 139, 1971.

3. Gorodetskiy, A. K., M. S. Malkevich, A. P. Orlov and V. I. Timofeyeva. Results of Measurements of Terrestrial Emission in the Spectral Region of 10 - 12 Micrometers from the Satellite Kosmos-243. Izvestiya AN SSSR, Fizika atmosfery i okeana, 6, No. 5, 477, 1970.

4. Gurvich, A. S. and V. N. Yuferev. Use of Thermal Radiation of the Ocean to Correct the Sensitivity of Satellite Radiometers. Izvestiya AN SSSR, Fizika atmosfery i okeana, 6, No. 6, 523, 1970.

5. Gorodetskiy, A. K., M. S. Malkevich and V. I. Syachinov. Determination of Cloud Height Based on Radiation Measurements from Kosmos-320. Doklady AN SSSR, Matematika, i Fizika, 200, No. 3, 588, 1971.

Translated for GODDARD SPACEFLIGHT CENTER under contract No. NASw 2483 by SCITRAN, P. O. Box 5456, Santa Barbara, California, 93108.

STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
GSFC-43 b		

4. Title and Subtitle	5. Report Date
STUDY OF CLOUDINESS PARAMETERS BASED ON MEASUREMENTS FROM THE KOSMOS-384 SATELLITE	July, 1973
	6. Performing Organization Code
7. Author(s) A. B. Akvilonova, A. Ye.Basharinov, A.K. Gorodetskiy, A.S. Gurvich, M.S. Krylova, B.G. Kutuza, D.T. Matveyev, and A. P. Orlov	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address SCITRAN, P. O. Box 5456, Santa Barbara California, 93108	11. Contract or Grant No. NASw 2483
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address GODDARD SPACE FLIGHT CENTER Greenbelt, Maryland 20771	14. Sponsoring Agency Code

15. Supplementary Notes

Translation of: Issledovaniya parametrov oblachnosti po izmereniyam so sputnika "kosmos-384".

Source: Izvestiya Akademii Nauk SSSR, Fizika Atmosfery i Okeana, Vol. IX, No. 2, pp. 187-189 1973.

16. Abstract

Atmospheric cloudiness parameters were determined based on radio observations of the Pacific Ocean at 0.8 cm and 10 microns.

17. Key Words (Selected by Author(s))	18. Distribution Statement
	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	7	